

Instruction and Maintenance Manual

RADIOLOGICAL SURVEY METER

OCD Item No. CD V-717, Model No. 1

Manufactured 1964



THE VICTOREEN INSTRUMENT COMPANY
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Figure 1. View of CD V-717, Showing Operating Controls and Case Sections

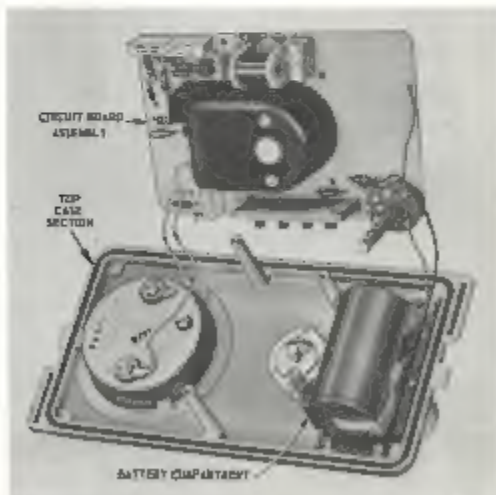


Figure 2. Circuit Board Assembly and Battery Compartment

1. PRECAUTIONS

1.1 HIGH IMPEDANCE CIRCUITRY:

The high megohm resistors, electrometer tube, ceramic switch-wafer, chamber connectors and bulkhead feed-thru, comprise the high impedance circuitry of the CD V-717. Any accumulation of dirt or grease on these parts will contribute to leakage currents that will cause upscale readings or lowered sensitivity which will be most evident on the 10^{-3} range. Therefore, it is desirable that these parts be handled as little as possible. These parts may be cleaned with a good quality solvent, such as alcohol, applied with a soft brush. The solvent should be free of any impurities or contaminants which might leave a residual film as the solvent evaporates. The entire instrument should be thoroughly dried by a low temperature bake-out (150°F or less) with the case open for one hour or dried with a desiccant.

1.2 SEMI-CONDUCTOR COMPONENTS (DIODES AND TRANSISTORS):

The semi-conductor components used in the CD V-717 may be damaged by prolonged exposure to excessive heat. When replacing any of these components the soldering operations should be accomplished as quickly as possible. Holding the lead between the component and the soldering point with a pair of pliers will decrease the heat transmitted to the component during the soldering operation.

1.3 ELECTROMETER TUBE:

When checking for a possible open filament of the electrometer tube, be certain to use an ohmmeter which has an output current of less than 10 milliamperes (ma). Current in excess of 10 ma may damage or even destroy the filament.

2. GENERAL DESCRIPTION

2.1 INTRODUCTION:

The Victoreen CD V-717, Model 1, portable monitoring instrument measures gamma radiation dose rates as high as 500 roentgens per hour (R/hr). It is designed to be used by radiological Civil Defense personnel in determining radioactive contamination levels that may result from an enemy attack or other nuclear disasters.

The CD V-717 consists of three case sections. The top section contains the meter and almost all of the circuit. The bottom section contains the ion chamber and provides for storage of the 25 feet of cable and the storage spool. The center section provides for electrically connecting the circuit board on the top section to the chamber from the bottom section. The case sections are electrically connected through two triaxial connectors which mate when the case sections are locked together. The instrument may be operated as a hand-held portable type survey instrument when all case sections are locked together, or, the bottom section of the case may be removed and the 25 foot triaxial cable employed to allow remote operation of the ion chamber detector. Instrument accuracy on each of its four ranges is within $\pm 20\%$ of the true dose rate from Cs^{137} or Co^{60} gamma radiation. This accuracy is maintained throughout a temperature range of -30°F to $+125^{\circ}\text{F}$, relative humidities to 100% and at altitudes from sea level to 25,000 feet. Use of the remote cable feature should give less than $\pm 5\%$ change in reading.

2.2 IONIZING ELEMENT:

The detecting element in the CD V-717 is an hermetically sealed ionization chamber. This chamber is located in the front portion of the bottom case section of the instrument, as shown in Figure 6, to make the instrument nearly equally sensitive to radiation from the bottom and front. The ionization

chamber plus the instrument case will together total more than 1000 milligrams per square centimeter (mg/cm^2) in effective thickness to make the instrument insensitive to beta rays lower than 2 million electron volts (MeV) in energy. The ionization chamber is hermetically sealed to eliminate changes in sensitivity due to changes in air pressure resulting from altitude changes, temperature changes, and moisture effects. A 25 foot triaxial cable is stored on a removable spool directly behind the ion chamber to allow remote operation of the chamber from the instrument. Use of the cable increases the time required for similar response, but does not otherwise alter the instrument characteristics. The bottom section of the case housing the ion chamber is removed for remote operation.

1.3 ELECTRONIC CIRCUITRY:

All electrical components which make up the circuitry are fastened to a printed circuit board. The circuitry serves to measure the minute current from the ionization chamber which indicates the presence of ionizing radiation. The high impedance components are housed in a light-tight enclosure for protection and shielding. The circuit board and the battery are enclosed in the center case section. The triaxial bulkhead connector which connects the ion chamber to the rest of the high impedance circuitry is located on the center case section. Two cast pins project from the center case section to protect the connector from accidental damage.

1.4 BATTERY:

The CD V-717 is powered by one "D" size flashlight cell. The battery will operate the instrument continuously for over 100 hours and much longer on an intermittent basis.

1.5 METER AND CONTROLS:

The CD V-717 uses a ruggedized, sealed meter to meet the instrument requirements for water-tightness, shock and vibration resistance. Two operating controls are provided. One control is a selector switch which turns the instrument on, checks its operation and serves to select the proper range. The second is a zero control which is used to adjust the supply voltages to compensate for battery aging and temperature variations, thus, insuring rated accuracy for any readings taken.

1.6 PHYSICAL FEATURES:

The instrument is housed in a die cast aluminum three part case with a root cantilever handle keyed and bolted in place. Carrying strap hooks and the zero control guard are permanently molded in. The nameplate and control knob information is indelibly engraved into the case top. Draw pull catches serve to fasten the three case sections together. Water-tightness is insured by closed cellular sponge rubber gaskets between the case sections. The instrument is operable with the case bottom removed. The battery is housed in a high-impact resistant plastic case which cannot be corroded by leaking battery fluids. However, metal parts may be corroded. The battery has is designed to be mechanically selective so that the battery cannot be inserted backwards. The instrument is approximately 9" long, 4½" wide and 7" high, excluding the handle. The instrument weight is 5½ pounds and will float in water.

2. THEORY OF OPERATION

2.1 IONIZATION CHAMBER:

The detecting element of the CD V-717 is an hermetically sealed air filled ionization chamber. It consists of a conducting cylindrical container called the shell and a thin paper and aluminum disc called the collector, located in the center of the shell. The shell is the positive electrode and the collector the negative electrode. The collector is insulated from the shell by an extremely

high resistance feed-thru insulator. A voltage, called the collecting voltage, is applied between these two chamber electrodes. This makes the shell approximately 50 volts positive with respect to the collector. See Figure 3. Radiation, passing through the chamber, causes ionization of the air molecules contained within the chamber. These charged particles or ions are attracted to the chamber electrode having the opposite charge, i.e., positive ions move toward the center electrode of the chamber and negative ions move toward the shell.

The arrival of these ions at the chamber electrode constitutes a current which is proportional to the number of ions collected. Since the number of ions created is proportional to the radiation intensity, this ionization current is proportional to the radiation intensity in the ionization chamber.

3.2 INPUT CIRCUIT:

The ionization current is extremely small—about 6 micro-microamperes at 0.5 R/hr which is full scale on the most sensitive range. It flows through a very high resistance (100,000 megohms) high megohm resistor connected to the collector of the ionization chamber as shown in Figure 3. This ionization current develops a voltage drop of about 1.1 volts across the high megohm resistor with the polarity as shown.

The voltage developed is applied to the grid of a vacuum tube for amplification. Any of the minute ionization current flowing to the grid of the tube instead of through the high megohm resistor would result in amplification of only a portion of the signal. A special vacuum tube called an electrometer tube capable of amplifying voltages at extremely small grid currents is used to prevent this error. This tube is connected as a triode as shown in Figure 3.

3.3 MEASURING CIRCUIT:

In order to permit serving the instrument in a radiation field, a section of the selector switch is used to short circuit the high megohm resistor and prevent any ionization signal from being sensed by the input circuit on the "ZERO" position. A "ZERO" control is located on the top of the instrument for balancing out static plate current. This balancing is accomplished by changing electrometer tube voltages by means of the potentiometer, R2. The measurement of the grid voltage of the electrometer tube is accomplished by metering the change in plate current directly. The static plate current is cancelled by running a reverse current, supplied by the battery BT1, through the meter. The magnitude of this current is fixed by the backing resistor R11.

Sensitivity of the instrument is changed by switching high megohm resistors, which is accomplished by the selector switch.

3.4 POWER SUPPLY CIRCUIT:

Three separate d.c. voltages are required by the measuring circuit as shown in Figure 3. These are the plate voltage supply of 10.5 volts, the grid bias supply of -3.2 volts and the ion chamber collecting voltage of 50 volts.

All of these voltages are obtained from a transistor oscillator circuit. The transistor Q1, driven by the battery BT1 through the lower portion of the primary of Transformer T1, constitutes this oscillator, with feed-back to the base of Q1 from the upper portion of the transformer via condenser C1 serving to sustain oscillation. The three output voltages are rectified from the a.c. output of the secondary of T1, by rectifiers CR1, CR2, and CR3, as shown.

Variations in output voltage with battery voltage and load current changes are prevented by the regulating network of R5 and R6. This network feeds back a portion of the plate supply voltage to the base of the transistor Q1 so as to control the bias current and hence, the battery current and magnitude of oscillation in such a fashion as to keep the plate voltage constant. This regulating method limits the battery drain through Q1 when the battery is new and is hence a method contributing to long battery life.

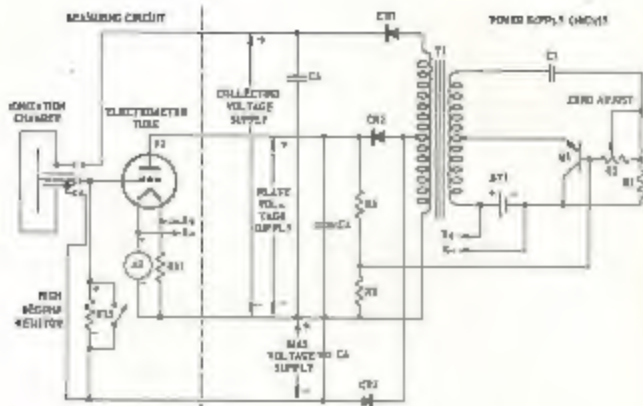


Figure 3. Simplified Schematic Circuit Diagram

4. INSTALLATION

4.1 INSPECTION:

The instrument is shipped with a battery and a carrying strap removed from the instrument and packed separately. Inspect the battery for possible leakage before installation. Do not install a leaking battery. Inspect the instrument for damage in shipment. If damage is apparent the battery should not be installed, thus preventing further damage due to possible short circuits.

4.2 BATTERY INSTALLATION:

Open the instrument by snapping open the draw pull catch at each end of the case top and separating the top from the center case section. Pull the case top straight up from the center case section, so as not to rouse the circuit board to seize on the barrel of the feed-thru connector. It is important not to touch any of the high impedance circuitry, such as the bulkhead feed-thru connector, the cable connectors, and the ion chamber connection. This exposed the battery box as shown in Figure 4, insert the battery in the battery box observing the indicated polarity. (The battery box is designed to be mechanically selective so that the battery cannot be inserted with reversed polarity). Close the instrument by aligning the top and the center case sections and squeezing together gently. The center case section has two ribs cast into the sides which prevent reversing the top case section relative to the center case section. Make sure the two case sections are properly oriented and in the closed position before attempting to close the draw pull catches. Snap the draw pull catches closed.

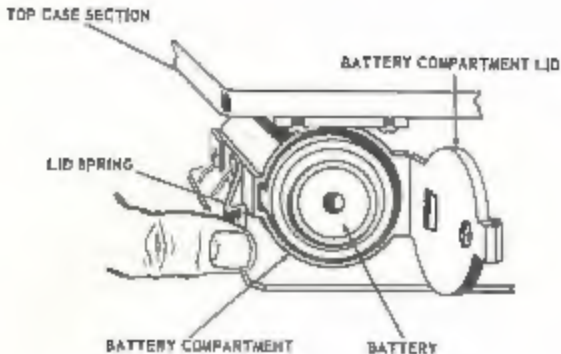


Figure 4. View of Battery Compartment Opened

4.3 SHOULDER STRAP INSTALLATION:

The carrying strap and two carrying strap slides and clips are packed separately. They are affixed to the cast-in carrying strap loops in the end of the case top section as shown in Figure 5, and the length is adjusted to suit the operator. The strap may or may not be used as desired by the monitor.

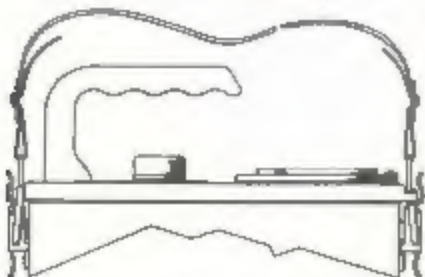


Figure 5. Method of Attaching Shoulder Straps

5. OPERATION

5.1 ADJUSTMENTS AND READINGS

There are three simple basic steps recommended for proper operation of the UD V-712. They are described as follows:

Step 1. Zero Adjust

Turn the instrument on by turning the selector switch from "OFF" to the "ZERO" position. Wait about a minute to allow the electrometer tube to warm up, then adjust the "ZERO" control until the meter needle indicates zero on the meter.

CAUTION

If the instrument is not zeroed properly, readings taken in any of the four ranges will be erroneous.

Step 2. Circuit Check

Turn the selector switch counter clockwise from the "ZERO" position through the "OFF" position to the "CIRCUIT CHECK" position. This position is spring-loaded to return to "OFF". The selector switch must be held in this position for the circuit check. The meter should read in or above the red outlined section labeled "CIRCUIT CHECK". If it does not, either the battery is low or trouble exists in the circuit. See Sections 6 and 8 for proper procedures. Make certain the instrument is zeroed before making the circuit check.

CAUTION

Even if the circuit check response is satisfactory, the instrument still may not respond to radiation properly; because, neither the ion chamber or its output signal being delivered to the grid of the electrometer tube is checked. Either (1) a defective ion chamber, (2) a break in the signal path, or (3) a dirty (leaky) connector will result in the instrument not properly measuring radiation or in some cases not provide any response to radiation.

A low or dead battery is indicated by inability to zero the instrument or by a meter reading below the check band when the selector switch is in the "CIRCUIT CHECK" position.

Step 3. Range Selection and Reading

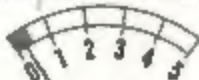
Turn the selector switch to the "X100, X10, X1, or X0.1" range as necessary to obtain an upscale reading on the meter.

The meter reading observed must be multiplied by the factor indicated by the position of the selector switch to obtain the radiation dose rate in R/hr.

EXAMPLE:

METER READING	3.8
RANGE	X100

INTENSITY OF RADIATION	380 R/hr



READINGS SHOULD NOT BE TAKEN OUT POINTER INDICATING IN LOWER 10% OF SCALE (BETWEEN 0.1-1.0). TURN TO NEXT MOST SENSITIVE RANGE (X100). POINTER INDICATES IN UPPER 10% OF SCALE (BETWEEN 4.0-5.0).

Another example is a meter reading of 2.4 on the "X10" range which indicates a dose rate of 24 R/hr while the same reading obtained with the instrument turned to the "X100" range corresponds to 240 R/hr.

It is recommended that the instrument be kept turned off, except for periods where frequent readings are required, in order to conserve battery life. The "ZERO" or "CIRCUIT CHECK" may be performed at any time, whether the instrument is in a radiation field or not.

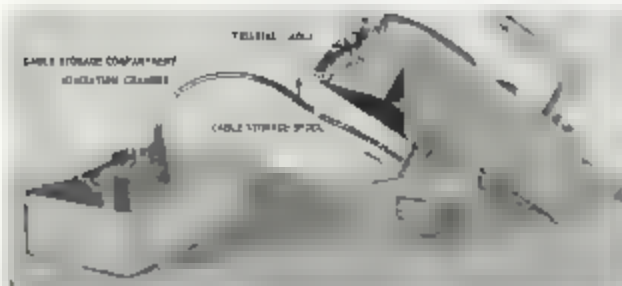


Figure 6 Remote Operation Using Cable Assembly

3.2 REMOTE OPERATION USING CABLE ASSEMBLY:

- Release the draw pul: catches holding the bottom case section to the center case section, and separate the two case sections.
- Remove the cable from its stored position behind the ion chamber and carefully unwind it from the spool so as to avoid kinking and tangling. It shouldn't slip off side of spool, pull straight off of spool.
- Connect the threaded cable plug to the ion chamber beryllium gas connector and slide the push fit cable plug onto the bulkhead feed-thru on the bottom of the center case section.
- In order to rest the upper portion of the instrument on a table or the like, slide the cable through the slot in the flange of the cable storage spool and rest the rear of the boot covering the push-fit connector in the semi-circular cut out in the spool case. See Figure 6. This prevents sharp bends and provides a stable rest for the instrumenting portion of the instrument.
- Place the bottom case section containing the ion chamber upside down at any point within cable reach where it is desired to monitor the radiation environment, such as outside a shelter area. If the cable must pass through any doors or windows, adequate precautions must be taken to prevent crushing, sharp kinking or cutting of the cable. The cable provided with the CR-5 is the largest which can be stored in the space provided, but it still must be treated as a miniature cable, and as such, is quite vulnerable to damage by unnecessarily rough or careless handling. The braided cable connector which mates with the ion chamber is designed to resist disconnection in the face of water when pulled. The push-on connector at the instrument is resistant to the entry of moisture, but is not intended to be waterproof.
- The time required to obtain a satisfactory dose rate indication is considerably increased when using the cable with the remote detector. Allow at least four minutes for the meter to reach a steady value when using the X0.1 range, 10 seconds when on the X1 range, and 9 seconds on the other two ranges.

When reassembling the instrument after opening chamber doors, be sure to check the alignment of the chamber doors. The doors should be closed and the instrument should be checked for proper operation. The doors should be closed and the instrument should be checked for proper operation. The doors should be closed and the instrument should be checked for proper operation.

NOTE

A certain amount of testing may be decided by placing the chamber in a dry place bag and checking the back. The bag should be checked for proper operation. The bag should be checked for proper operation. The bag should be checked for proper operation.

6. OPERATOR'S MAINTENANCE

6.1 BATTERY REPLACEMENT

Battery replacement is not used whenever the instrument can no longer be operated when the battery is low. The battery should be replaced when the instrument can no longer be operated. The battery should be replaced when the instrument can no longer be operated.

6.2 CLEANING

WARNING

Do not use solvents on the plastic parts. To clean use soap and water. The battery has tested with the plastic parts. The battery has tested with the plastic parts.

Any plastic parts which may be washed with the bulkhead. The plastic parts may be washed with the bulkhead. The plastic parts may be washed with the bulkhead.

7. PREVENTIVE MAINTENANCE

7.1 PREVENTIVE MAINTENANCE

The maintenance procedures in this section should be followed every time the instrument is used. The maintenance procedures in this section should be followed every time the instrument is used.

Preventive maintenance should be carried out as follows:

- Check the battery for proper operation. The battery should be checked for proper operation. The battery should be checked for proper operation.
- Inspect the battery for proper operation. The battery should be inspected for proper operation. The battery should be inspected for proper operation.
- Inspect the battery for proper operation. The battery should be inspected for proper operation. The battery should be inspected for proper operation.

The battery should be removed from the instrument and stored separately if the instrument is to be stored more than a few weeks.

B. CORRECTIVE MAINTENANCE

WARNING

Calibration should be attempted only by personnel trained and licensed to use radioactive isotope sources. A "CAL" control setting should not be changed unless prepared to readjust in a radiation field of known intensity.

B.1 CALIBRATION:

The CL-5 is calibrated by being placed in a gamma radiation field of known dose rate. Such fields are most commonly produced by using a radioactive material such as radium-226. As an example, a 1000 radium source will produce a radiation dose of 4 R/hr at a distance of 20 inches. The CL-5 should read this dose rate when so positioned with the center of the instrument at the source. If it does not, the instrument should be recalibrated. This is accomplished by separating the top and the center case sections and adjusting the individual "CAL" screws for the corresponding ranges as the proper reading is indicated on the meter (see Figure 1). The distance from the center of the CL-5 to within 1/2 inch to the calibration source should be at least 2 inches to obtain reasonable geometry, minimizing variation in radiation intensity throughout the entire volume of the ionization chamber.

The instrument must be reassembled to see what effect each adjustment has on the instrument reading and to determine if more or less adjustment is required.

B.2 DISASSEMBLY FOR CORRECTIVE MAINTENANCE:

1. Detach the upper section drive pulley screws and remove the instrument top from the center case section.
2. Remove the battery from the battery box.
3. Remove the knob from the dose control. It is not necessary to remove the selecton switch knob.
4. Remove the four screws which secure the circuit board assembly to the top case section. Do not lose the ground on air spring. Press up the control shaft and lightly pull up the unit board assembly to release it from the instrument case top section. The

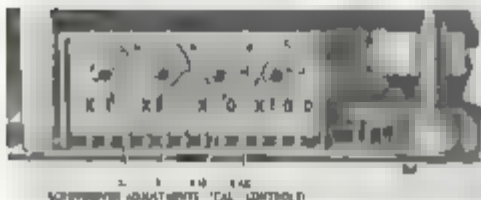
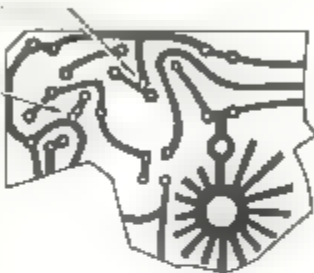


Figure 7. Range Calibration Adjustments

- d. If case (2) occurs, calibrate Unit as in 8.1. If 1 or (3) appears, a step adjustment in the feedback loop gain of the electrometer valve—power supply is in order. This is accomplished by shorting out or adding into the active circuit resistors R5 and/or R17.
- e. For case (3) make sure both resistors are in the circuit by removing the solder bridges to ground on the circuit board. See figure below.

WOLDER BRIDGE HERE
SHORTS OUT R5

SOLDER BRIDGE HERE
SHORTS OUT R5 AND R17



- f. For case (4), short out one or both resistors as needed to increase the speed of response to an acceptable rate.
- g. Calibrate unit as in 8.1.

8.4 TROUBLE SHOOTING:

The majority of the electrical components of the CD V² are standard parts familiar to electronic technicians and are readily checked by conventional means. The electrometer valve, the high megohm resistor, the ion chamber insulator and the ceramic switch section are the only components requiring special precaution. These components are all part of the high resistance input circuit. THE INSULATING PORTIONS OF THESE FOUR COMPONENTS SHOULD NOT BE HANDLED. They should be touched only with clean tools when repairs are made. If surface leakage on any of these items is suspected, cleaning with clean alcohol using a clean camel hair brush is recommended. Acid and solder should not be used. Avoid solder flux splattering on these components when repairs are made. Dry thoroughly with dry air or in a warm oven.

The battery as well as the measuring circuit are checked by the "CIRCUIT CHECK." If trouble exists, the battery should be checked with a battery tester.

Troubleshooting may be traced with the aid of the schematic circuit diagrams, Figure 9. Voltage measurements shown on this diagram are measured with respect to "point" and are those obtained with a voltmeter having a sensitivity of 20,000 ohms per volt. Such voltage checks should be taken with the instrument selector switch turned to the "ZERO" position and with the zero control adjusted so that the instrument reads zero.

The following troubles and corrective action are presented as an aid to trouble shooting.

TROUBLE SHOOTING CHART

<i>Trouble and Cause</i>	<i>Corrective Action</i>
NO READING	
Battery Low	Replace the Battery
Corroded Battery Contacts	Clean or Replace the Contacts
Meter Damaged	Replace Meter
Chamber Damaged	Replace Chamber
Open Connection	Inspect Slider Joints, Ion Chamber, Cable Connections, Battery and Meter Leads
METER WILL NOT ZERO (Reads Upward)	
Tube Defective	Replace Tube
Improper Grid Bias or Plate Voltage	Check Tube Operating Voltages, Look For Opens or Shorts On Circuit Board
METER WILL NOT ZERO (Reads Downward)	
Fogged Downward With Good Battery	Turn Off Instrument, Turn Zero Full CW Turn Instrument On, Bring Zero Slowly CW Until Meter Zeroes
Battery Low	Replace Battery
Defective Tube	Check Tube Filament
Translator Defective	Replace Translator
INSTRUMENT READS LOW	
Calibration Control Disturbed	Check Calibration
Defective Tube	Replace Tube
Meter Damaged	Replace Meter
Defective Chamber	Replace Chamber
Dirty High Resistance Components	Clean High Resistance Components
INSTRUMENT READS HIGH	
Calibration Control Disturbed	Check Calibration
Damaged High Megohm Resistor	Replace High Megohm Resistor
Open Switch Contact	Check Switch Contact and Replace if Defective
Dirty High Resistance Components	Clean High Resistance Components
UNUSUAL READING ON ONE OR MORE RANGES	
	Dry Out Wilds Heat 150° F) or Less or Neutront
NO RESPONSE OR ERRATIC RESPONSE TO RADIATION	
Loss of Contact Between Case Sections	Inspect and Repair All Contacts
Broken Cable	Replace Cable
Loose Cable Connections	Repair Cable Connections

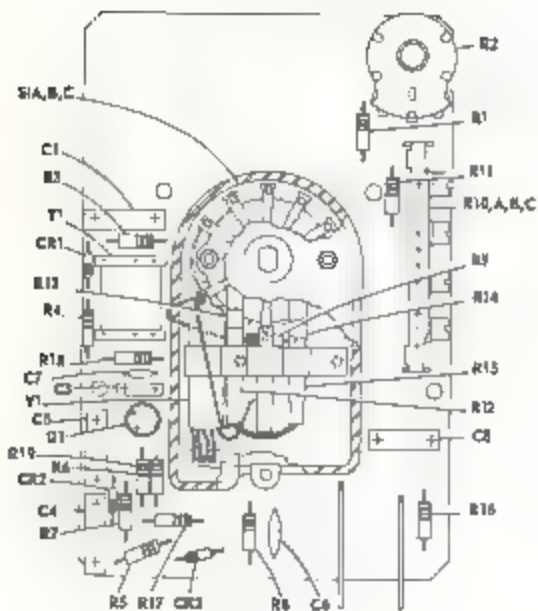


Figure 8. Circuit Board Assembly

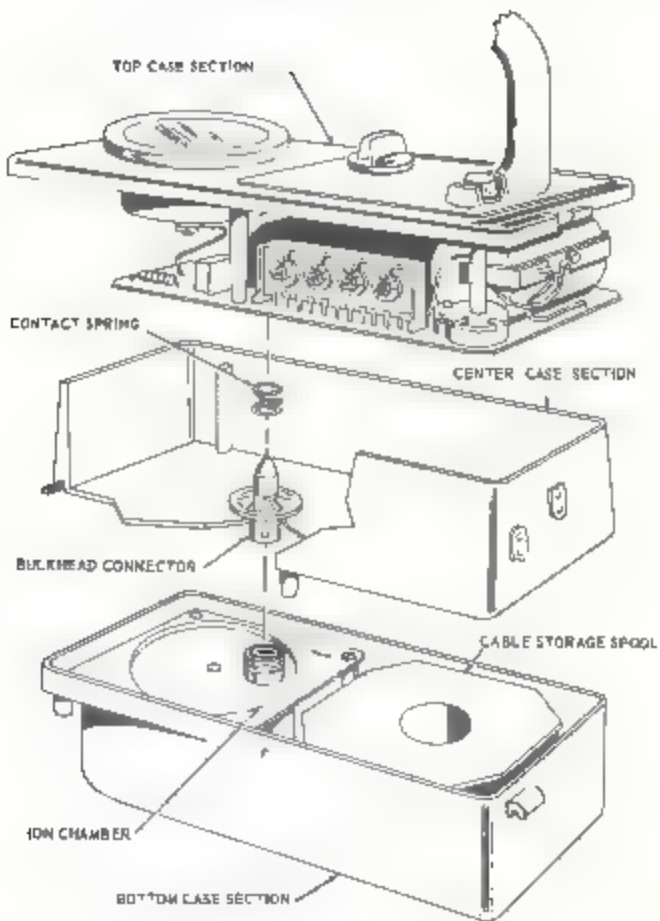


Figure 9. Exploded View

9 ELECTRICAL COMPONENTS

Unit Symbol	Designation	Quantity Per Instrument	Manufacturer	Part No.	Quantity Per Instrument
1	Resistor	1	John E. Farn	110-4 110	2
2	Capacitor	1	John E. Farn	110-4 110	2
3	Inductor	1	John E. Farn	110-4 110	2
4	Transformer	1	John E. Farn	110-4 110	2
5	Relay	1	John E. Farn	110-4 110	2
6	Switch	1	John E. Farn	110-4 110	2
7	Motor	1	John E. Farn	110-4 110	2
8	Generator	1	John E. Farn	110-4 110	2
9	Antenna	1	John E. Farn	110-4 110	2
10	Waveguide	1	John E. Farn	110-4 110	2
11	Coil	1	John E. Farn	110-4 110	2
12	Core	1	John E. Farn	110-4 110	2
13	Shield	1	John E. Farn	110-4 110	2
14	Ground	1	John E. Farn	110-4 110	2
15	Isolation	1	John E. Farn	110-4 110	2
16	Protection	1	John E. Farn	110-4 110	2
17	Interference	1	John E. Farn	110-4 110	2
18	Shielding	1	John E. Farn	110-4 110	2
19	Grounding	1	John E. Farn	110-4 110	2
20	Isolation	1	John E. Farn	110-4 110	2
21	Protection	1	John E. Farn	110-4 110	2
22	Interference	1	John E. Farn	110-4 110	2
23	Shielding	1	John E. Farn	110-4 110	2
24	Grounding	1	John E. Farn	110-4 110	2
25	Isolation	1	John E. Farn	110-4 110	2
26	Protection	1	John E. Farn	110-4 110	2
27	Interference	1	John E. Farn	110-4 110	2
28	Shielding	1	John E. Farn	110-4 110	2
29	Grounding	1	John E. Farn	110-4 110	2
30	Isolation	1	John E. Farn	110-4 110	2
31	Protection	1	John E. Farn	110-4 110	2
32	Interference	1	John E. Farn	110-4 110	2
33	Shielding	1	John E. Farn	110-4 110	2
34	Grounding	1	John E. Farn	110-4 110	2
35	Isolation	1	John E. Farn	110-4 110	2
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38	Shielding	1	John E. Farn	110-4 110	2
39	Grounding	1	John E. Farn	110-4 110	2
40	Isolation	1	John E. Farn	110-4 110	2
41	Protection	1	John E. Farn	110-4 110	2
42	Interference	1	John E. Farn	110-4 110	2
43	Shielding	1	John E. Farn	110-4 110	2
44	Grounding	1	John E. Farn	110-4 110	2
45	Isolation	1	John E. Farn	110-4 110	2
46	Protection	1	John E. Farn	110-4 110	2
47	Interference	1	John E. Farn	110-4 110	2
48	Shielding	1	John E. Farn	110-4 110	2
49	Grounding	1	John E. Farn	110-4 110	2
50	Isolation	1	John E. Farn	110-4 110	2
51	Protection	1	John E. Farn	110-4 110	2
52	Interference	1	John E. Farn	110-4 110	2
53	Shielding	1	John E. Farn	110-4 110	2
54	Grounding	1	John E. Farn	110-4 110	2
55	Isolation	1	John E. Farn	110-4 110	2
56	Protection	1	John E. Farn	110-4 110	2
57	Interference	1	John E. Farn	110-4 110	2
58	Shielding	1	John E. Farn	110-4 110	2
59	Grounding	1	John E. Farn	110-4 110	2
60	Isolation	1	John E. Farn	110-4 110	2
61	Protection	1	John E. Farn	110-4 110	2
62	Interference	1	John E. Farn	110-4 110	2
63	Shielding	1	John E. Farn	110-4 110	2
64	Grounding	1	John E. Farn	110-4 110	2
65	Isolation	1	John E. Farn	110-4 110	2
66	Protection	1	John E. Farn	110-4 110	2
67	Interference	1	John E. Farn	110-4 110	2
68	Shielding	1	John E. Farn	110-4 110	2
69	Grounding	1	John E. Farn	110-4 110	2
70	Isolation	1	John E. Farn	110-4 110	2
71	Protection	1	John E. Farn	110-4 110	2
72	Interference	1	John E. Farn	110-4 110	2
73	Shielding	1	John E. Farn	110-4 110	2
74	Grounding	1	John E. Farn	110-4 110	2
75	Isolation	1	John E. Farn	110-4 110	2
76	Protection	1	John E. Farn	110-4 110	2
77	Interference	1	John E. Farn	110-4 110	2
78	Shielding	1	John E. Farn	110-4 110	2
79	Grounding	1	John E. Farn	110-4 110	2
80	Isolation	1	John E. Farn	110-4 110	2
81	Protection	1	John E. Farn	110-4 110	2
82	Interference	1	John E. Farn	110-4 110	2
83	Shielding	1	John E. Farn	110-4 110	2
84	Grounding	1	John E. Farn	110-4 110	2
85	Isolation	1	John E. Farn	110-4 110	2
86	Protection	1	John E. Farn	110-4 110	2
87	Interference	1	John E. Farn	110-4 110	2
88	Shielding	1	John E. Farn	110-4 110	2
89	Grounding	1	John E. Farn	110-4 110	2
90	Isolation	1	John E. Farn	110-4 110	2
91	Protection	1	John E. Farn	110-4 110	2
92	Interference	1	John E. Farn	110-4 110	2
93	Shielding	1	John E. Farn	110-4 110	2
94	Grounding	1	John E. Farn	110-4 110	2
95	Isolation	1	John E. Farn	110-4 110	2
96	Protection	1	John E. Farn	110-4 110	2
97	Interference	1	John E. Farn	110-4 110	2
98	Shielding	1	John E. Farn	110-4 110	2
99	Grounding	1	John E. Farn	110-4 110	2
100	Isolation	1	John E. Farn	110-4 110	2

9. PARTS LIST

9.1 ELECTRICAL COMPONENTS (Continued)

Circuit Symbol	Description	Function	Manufacturer	Mfg. Part No.	Victoreen Part No.	Quantity Per Instrument
R19	Resistor, 27K, 5W, 10%	Voltage Divider	Allen Bradley Co.	ED7731	184-393	1
S1A	Switch Section, Photoic W/af	Battery Switch — ON-OFF	Sol. Grigsby Co.	28781-444A	817-69	2
S1B	Switch Section, Ceramic W/af	High Megohm Resistor Selector	Victoreen	817-68	817-68	1
S1C	Switch Section, Phenolic W/af	Range Cal. Pot. Selector	Sol. Grigsby Co.	28781-444B	817-69	1
T1	Transformer	Oscillator — Power Supply	Victoreen	14-61	14-61	1
V1	Tube: 6X86	Ion Current Detector	Victoreen	33-134	33-134	1
BT1	Battery, 1.5V	d. c. Power Supply w/ Oscillator and VX86 Filament	Union Carbide Consolidated Co.	#950	16-4	1

9.2 MECHANICAL COMPONENTS

Description	Function	Manufacturer	Mfg. Part No.	Victoreen Part No.	Quantity Per Instrument
Strap Fastener	Attaches Shoulder Strap	Victoreen	813-47	813-47	2
Shoulder Strap	Carrying Strap	Victoreen	700-81	700-81	1
Strap Buckle	Carrying Strap Length Adjustment	Waterbury Buckle Co.	807 5047	710-44	2
Case Bottom Section	Bottom of Instrument Case	Victoreen	817-6	817-6	1
Knob	Zero Adjust	Harry Davies Molding Co.	1450-AC	9-13	1
Battery Box	Holds Batteries	Victoreen	817-59	817-59	1
Ion Chamber Assembly	Radiation Detector	Victoreen	817-60	817-60	1
"V" Ring	Shaft End	Cleveland Ball Bearing Co.	5427-3	46-38	2
Detector Cable Assembly	Remote Detector Operation	Victoreen	817-36	817-36	1
Carrier Case Section	Circuit Housing	Victoreen	817-7	817-7	1
Swirl Drive Shaft	Connects Switch Index to Swirl W/dm	Victoreen	817-25	817-25	1
Shield Base	Shields High Impedance Ckt.	Victoreen	817-22	817-22	1
Chamber Terminal Contact	Connects Unit Chassis to Elastic starter Tube Circuit	Victoreen	813-19	813-19	1
Tube Sucker	Holds Thermometer Tube	Elco Mfg. Corp.	0107NS12000000	33-49	1
Ckt. Board, Personnel	Supports Components	Victoreen	817-61	817-61	1
Knob	Selective Control	Harry Davies Molding Co.	1500-XL	9-9	1
Merer Gasket	Case Top — Merer Seal	Victoreen	817-73	817-73	1
Switch Index	Positions Selector Switch	Victoreen	813-36	813-36	1
Case Top and Handle Assembly	Instrument Carrying Handle and Top of Instrument	Victoreen	817-44	817-44	1

9.2 MECHANICAL COMPONENTS (Continued)

Description	Function	Manufacturer	Mfr. Part No.	Victoreen Part No.	Quantity Per Instrument
Case Gasket	Case Top — Case Bottom Seal	Victoreen	720-157	720-157	1
Draw Pull Coaches	Holds Case Sections Together	Cosbitt	13797C	700-74	4
Buck Contact Spring	Makes Positive Contact to Battery	Victoreen	817-57	817-57	1
Contact Spring	Makes Negative Contact to Battery	Victoreen	817-109	817-109	1
Lid Spring	Holds Battery Box Closed	Victoreen	817-11	817-11	1
Bulkhead Connector	Makes Contact Between Ion Chamber and High Impedance Circuit	Victoreen	817-53	817-53	1
Control Spring	Connects Guard Ring to Circuit Board	Victoreen	12-39	12-39	1
Cable Spool	Stores Precision Cable	Victoreen	817-28	817-28	1
Ground Contact Spring	Grounds Circuit Board to Case	Victoreen	817-34	817-34	1
Instruction Manual	Operation and Maintenance Manual	Victoreen	817-4	817-4	2

9.3 LIST OF MANUFACTURERS

AERVOX CORPORATION, Myrtle Beach, South Carolina
 ALLEN HILASLEY COMPANY, 146 West Greenfield Avenue, Milwaukee 4, Wisconsin
 CENTRALAIR ENGINEERED, 900 East Kelle Avenue, Milwaukee, Wisconsin
 CLEVELAND BALL BEARING COMPANY, 2802 Euclid Avenue, Cleveland 15, Ohio
 CORBIN CABINET LOCK DIVISION,
 AMERICAN HARDWARE CORPORATION, New Britain, Connecticut
 CTS CORPORATION, 1142 Samsbury Avenue, Eastford, Indiana
 BLOO MANUFACTURING CORPORATION, 297 Street, Philadelphia 23, Pennsylvania
 FLAME UNION, INC., CENTRALAIR DIVISION, 918 E. Kelle Street, Milwaukee 1, Wisconsin
 HARRY DAVIES MOLDING COMPANY, 1400 North Wells Street, Chicago 11, Illinois
 INTERNATIONAL RESISTANCE COMPANY, 401 North Broad Street, Philadelphia, Pennsylvania
 JOHN E. FAST DIVISION,
 VICTOREEN INSTRUMENT COMPANY, 2810 Dixon Avenue, Chicago, Illinois
 RADIO MATERIALS COMPANY, 4245 West Bryn Mawr Avenue, Chicago 46, Illinois
 MAYHEIM MANUFACTURING COMPANY,
 SEMICONDUCTOR DIVISION, 350 Ellis Street, Mountain View, California
 KOPER CARBON COMPANY, SPECT RESISTANCE DIVISION, St. Marys, Pennsylvania
 STACKPOLE CARBON COMPANY, St. Marys, Pennsylvania
 STANDARD GILGUSLY, INC., 2083 North Hawthorne Avenue, Moline Park, Illinois
 UNION CARBIDE CORPORATION,
 CONSUMERS PRODUCTS DIVISION, 875 Green Tree Road, Parkway Center, Pittsburgh, Pennsylvania
 VICTOREEN INSTRUMENT COMPANY, 2810 North Avenue, Cleveland 3, Ohio
 WATERBURY BUCKLE COMPANY, 642 South Main Street, Waterbury 26, Connecticut



